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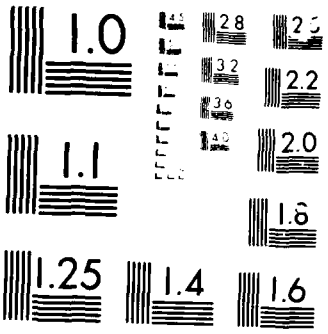
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CENTRAL DENTAL SURGICAL HANDPIECE DRIVE AIR (SHDA) SYSTEMS

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May 1986

Interim Report for Period January 1985 - December 1985

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USAF SCHOOL OF AEROSPACE MEDICINE
Aerospace Medical Division (AFSC)
Brooks Air Force Base, TX 78235-5301

NOTICES

This interim report was submitted by personnel of the Dental Investigation Service, Clinical Sciences Division, USAF School of Aerospace Medicine, Aerospace Medical Division, AFSC, Brooks Air Force Base, Texas, under job order DSB38900.

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The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

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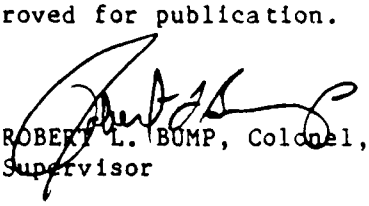

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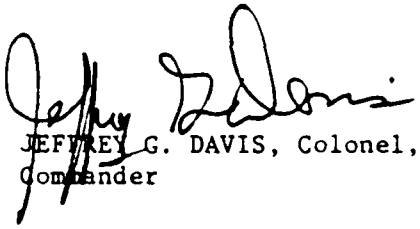

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This report includes the minimum requirements for central dental surgical handpiece drive air (SHDA) systems and associated centrally plumbed distribution networks for use in USAF dental health facilities. These specifications are interim until joint evaluations by the Dental Investigation Service and the Occupational and Environmental Health Laboratory establish standards for dental clinics.

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CONTENTS

CENTRAL DENTAL SURGICAL HANDPIECE DRIVE AIR (SHDA) SYSTEMS

1. INTRODUCTION.

1.1 Surgical Handpiece Drive Air. Surgical handpiece drive air (SHDA) is a cost-effective substitute for bottled nitrogen used to power pneumatic surgical handpieces. These high torque instruments are required to support routine exodontic procedures performed in dental treatment rooms (DTRs) designated for oral surgery in free-standing USAF dental clinics. Surgical handpiece drive air is not used for breathing or respiratory support of any kind, is not mixed with oxygen, and is not exhausted into the pharynx from powered instruments. Surgical handpiece drive air and the associated system and distribution network herein specified are a power source for surgical handpieces and are not an oilless medical air system. Therefore, National Fire Protection Association (NFPA) Standard 56F does not apply.

1.2 Equipment Demand. Surgical handpieces require a drive gas of higher constant pressure and significantly lower dewpoint than that specified for dental compressed air. The volume of SHDA required for facility support does not justify the increased equipment and energy costs required to increase dental compressed air quality and pressure parameters to satisfy SHDA standards.

1.3 System Functions. The SHDA system functions as a pressure boosting and drying unit for a portion of prerefined air (dental compressed air), producing drive gas of specified quality and pressure required by surgical rotary instruments.

1.4 Guidelines. The guidelines provided are minimum requirements for safe, proficient, reliable, and cost-effective production and distribution of SHDA of the quality, pressures, and flow rates essential to dental health care delivery. The information provided is applicable to all SHDA systems in new construction and system replacement projects and is intended to supplement and provide a basis for other design criteria, guide specifications, codes, and specifically Air Force Regulation 88-50, "Criteria for Design and Construction of Air Force Health Facilities."

2. DEFINITIONS.

2.1 Surgical Handpiece. Gas-operated rotary instruments intended specifically for use in oral surgery procedures, and designed for operation using Grade J nitrogen as classified by the Compressed Gas Association Air of Equivalent Purity.

2.2 Surgical Handpiece Drive Air. Dental compressed air which has been further processed to provide compressed air of specified quality, quantity, and pressure essential for the safe and proficient operation of surgical handpieces described herein.

2.3 Surgical Handpiece Drive Air System. An assembly composed of air pressure boosting device(s), receiver, dryer, filter, regulator, and all

other electrical, mechanical and fluidic devices, and interconnections for the production, refinement, storage, monitoring, and initial regulation of surgical handpiece drive air; designed and sized for intermittent operation; and terminating at the point of connection to the surgical handpiece drive air central distribution network.

2.4 Centrally Piped Distribution Network. All central plumbing and station outlet fixtures for distribution of surgical handpiece drive air, originating at the system regulator outlet and terminating at the station fixture outlet.

2.5 Station Outlet Fixture. An endpoint of the centrally piped surgical handpiece drive air distribution network consisting of a wall-mounted quick connect/disconnect device approved for use with high pressure nonflammable gas, for user connection.

2.6 System Demand. The maximum flow rate, at maximum system pressure, required of the system to maintain the specified network demand and the system dryer purge air requirement, per station outlet fixture.

2.7 Network Demand. The specified intermittent flow rate, at station pressure, required through the centrally piped distribution network to support the oral surgery DTRs programmed.

2.8 Purge Air Demand. The air-flow rate (maximum is specified), at manufacturer's specified pressure, required for reactivation/regeneration of desiccant media in the system regenerative desiccant dryer during one regenerating cycle (one column regeneration).

2.9 Station Demand. The intermittent flow rate, at station pressure, drawn from an active station outlet fixture by a surgical handpiece. The maximum rate does not exceed 6 cubic feet per minute (CFM) at station pressure. The use interval does not exceed 3 min/15-min period per station outlet fixture.

2.10 Minimum System Pressure. The specified minimum pressure limit permissible in the system, which may occur for brief periods during recovery from peak system demand.

2.11 Booster Cut-in Pressure. The system pressure (minimum is specified) at which the booster device(s) is (are) switched on. Booster cut-in pressure shall be higher than minimum system pressure in order to assure that boosters are operating during peak demand and recovery periods before minimum system pressure is reached.

2.12 Maximum System Pressure (Booster Cut-out Pressure). The maximum design pressure (minimum is specified) in the system, at which pressure the booster(s) is (are) switched off.

2.13 System Pressure Differential. The difference in pressure (maximum is specified) between maximum system (booster cut-out) pressure and booster cut-in pressure.

2.14 Station Pressure. The sustained specified pressure, within specified tolerance, required at each station outlet fixture of the centrally piped distribution network.

3. REQUIREMENTS.

3.1 Planned DTRs. U.S. Air Force dental facilities in which oral surgery DTRs are programmed shall be provided with a separate compressed air system and distribution network to supply surgical handpiece drive air to oral surgery DTRs.

3.2 Equipment Design. Surgical handpiece drive air, source systems, and centrally piped distribution networks are designed specifically to support the special requirements for surgical handpieces and should not be used for any other purpose.

3.3 Surgical Handpiece Drive Air.

3.3.1 Source air for the production of surgical handpiece drive air shall be dental compressed air.

3.3.2 The quality of surgical handpiece drive air relative to specific contaminants shall be as per the following limits:

Contaminant	Limit
A. Water	Dry to a pressure dewpoint of -40° C (-40° F), at not less than 150 psig.

Reference: American National Standards Institute Standard Z 86.1, 1973; and Compressed Gas Association (CGA) Pamphlet G-7.1.

B. Condensed Hydrocarbons	Not more than 0.1 parts per million (ppm) by weight (wt/wt) or 0.1 mg/L.

Reference: CGA Specification G-10.1 (Grade J).

C. Permanent particulates:	Less than 1.0 ppm wt/wt or 1.0 mg/L.

Reference: CGA Specification G-10.1 (Grade J).

3.3.3 The network demand for surgical handpiece drive air shall be according to the number of oral surgery (OS) DTRs programmed as per the following:

Number of OS DTRs	Network Demand (CFM)
1-2	6
3-4	12
5 and over	18

3.3.4 Minimum system pressure shall not be less than 150 psig.

3.3.5 Booster cut-in pressure shall not be less than 60 psig.

3.3.6 The maximum system pressure shall not be less than 170 psig, and shall be compatible with pressure limits recommended by the system dryer manufacturer.

3.3.7 The system pressure differential shall not exceed 10 psig.

3.3.8 The station pressure for surgical handpiece drive air at each station outlet fixture shall be as follows:

Designation	Pressure	Tolerance
SHDA 100	100 psig	+10, -0 psig

3.3.9 Plumbing friction losses have not been included in specified pressure and demand values and must be added to specified values where required by standard engineering practice to assure specified station outlet performance.

3.4 Surgical Handpiece Drive Air System.

3.4.1 The system shall include, but not be limited to, the following components listed in downstream order:

- Air pressure booster device(s)
- Air receiver
- Regenerative desiccant column dryer
- Afterfilter
- Pressure regulator
- Low pressure monitor and warning device

3.4.2 Pressure Boosting Devices.

3.4.2.1 The system shall be provided with one or more boosters with provisions for automatic operation. Multiple booster systems shall not be duplexed, but shall have provisions for automatic simultaneous operation.

3.4.2.2 Boosters shall be one- or two-stage, single- or double-acting units, powered by pneumatic, electric, or hydraulic means, or by a combination of these means.

3.4.2.3 Boosters shall not be powered by dental compressed air.

3.4.2.4 Boosters shall not contribute lubricating material to the booster output air.

3.4.2.5 Boosters shall be provided with drive power input and air output disconnects and/or valves for isolation during maintenance.

3.4.2.6 Booster/power unit assemblies shall be mounted on resilient vibration isolator pads. Vibration transmission to the source air system or to the other parts of the SHDA system shall be limited to less than 5% of the lowest frequency of vibration.

3.4.2.7 Booster intakes and outlets shall be connected to other components with flexible hose or flexible pipe.

3.4.3 The air receiver shall be an American Society of Mechanical Engineers (ASME) certified pressure vessel suitable for intended use. The receiver shall be provided with pressure-activated devices for automatic on and off switching of booster device(s); a pressure gage; a pressure relief (safety) valve; and automatic and manual condensate drains.

3.4.4 Regenerative Desiccant Dryer.

3.4.4.1 The dryer shall be a dual tower (column) heatless type with provisions for fully automatic operation.

3.4.4.2 The dryer shall be designed and installed such that no plumbing, interconnections or accessory device removal is required for recharging towers with desiccant.

3.4.4.3 Regeneration of dryer desiccant shall consume not more than 15% of the final dried air product for each purge cycle.

3.4.4.4 Station pressure and demand shall be continuous without interruption by dryer purge cycling.

3.4.5 Afterfilters shall be replaceable cartridge types 100% efficient in retention of solids 0.025 μm in diameter.

3.4.6 The system regulator shall be a relieving type with an outlet control range from 0 to 150 psig, and with a pressure gage on the output side with a range from 0 to 200 psig.

3.4.7 Low Pressure Monitor and Remote Warning Device.

3.4.7.1 An air pressure monitoring device shall be connected in the air line between the system afterfilter and system regulator.

3.4.7.2 The monitor shall be equipped with an audible alarm and a test button. The monitor shall be adjusted and connected to activate the audible alarm and the remote warning device when system pressure falls below the specified minimum.

3.4.7.3 The labeled remote warning device shall be located in the administration/records/reception area of the dental clinic.

3.4.8 System Component Sizing Criteria.

3.4.8.1 Booster devices shall be of sufficient output capacity to provide full system recovery from minimum system pressure to maximum system pressure in not more than 15 min.

3.4.8.2 Air receivers shall be of standard, commercially available sizes and of sufficient capacity to provide not less than 3 min of continuous network demand at station pressure and sufficient purge air for one dryer column regeneration cycle. Booster(s) may be operating to assist supply of air. The system pressure shall not drop below the specified minimum.

3.4.8.3 All drying, filtering, and regulating components of the system shall be sized for maximum potential output of the booster(s) at maximum system pressure.

3.4.9 System Interconnections.

3.4.9.1 Unless otherwise specified, all system interconnecting piping shall be type "K" or "L" seamless copper tubing, washed, and degreased. All valves and fittings shall be wrought copper, brass, or bronze. All joints shall be made with silver brazing alloy except at valves or equipment requiring threaded pipe connections. Threaded pipe connections shall be made by tinning male threads with soft solder.

3.4.9.2 System interconnections and components shall be suitable for not less than 190 psig working pressure and shall be tested with surgical dental compressed air or nitrogen to 250 psig.

3.5 Centrally Piped Distribution Network.

3.5.1 Pipe sizes for the central distribution network shall be adequate to assure delivery of not less than 6 cfm, at specified station pressure, through each station outlet fixture.

3.5.2 Station outlet fixtures shall be hospital grade, high pressure, wall mounted, and Diameter Index Safety System (DISS) units manufactured for medical gas use.

3.5.3 The distribution of station outlet fixtures shall be one per oral surgery DTR.

3.5.4 All piping, fittings, and connections for the centrally piped distribution network shall be as per paragraph 3.4.9.1.

3.5.5 The centrally piped distribution network shall be suitable for not less than 150 psig of working pressure, and shall be tested with surgical handpiece drive air or nitrogen to 200 psig.

4. DOCUMENTATION

4.1 Instructions. The contractor shall supply two complete sets of the manufacturer's operating and maintenance instructions as specified in

paragraph 4.2 to the local maintenance organization who shall be responsible for system maintenance. Bound set covers shall be labeled with the system name, building number, contractor's name, and contract number.

4.2 General Information.

4.2.1 The manual shall include an overall description and purpose of the system or equipment. The function and purpose of each system component shall be described. The description shall include the intended use, capabilities, and limitations of the system or equipment. If the manual covers more than one model of a system or equipment, or systems or equipment modified by field change, a description of the differences shall be provided. Quick-reference data shall be included and shall describe technical or design characteristics of the equipment. Examples of such data are:

- Descriptive (nameplate) data necessary to identify manufacturer, type, and model.

- Functional characteristics, such as: power and frequency requirements, voltage and amperage demands, outputs, and modes of operation.

- Rated outputs, such as: horsepower, cubic feet per minute, and revolutions per minute.

- Special characteristics, such as: operating temperatures, pressure, heat dissipation, and humidity.

4.2.2 A warning page, consisting of the more vital warnings extracted from those shown throughout the manual, shall be assembled and placed on the inside cover or in front of the first page(s) of the manual (See 4.2.7).

4.2.3 Operating instructions shall include routine and emergency procedures (manual and automatic) and safety precautions. Limits to be observed in the starting, operating, stopping, or shutting down of the equipment or system shall be provided. Adequate illustrative material shall be provided to identify and locate operating controls and indicating devices. The function of each operating control and indicating device shall be included. Emergency operating instructions shall include alternate procedures to be followed when normal operation is not possible because of emergency conditions, such as power or lubricating oil failure. Emergency operating instructions and procedures shall be located for quick and ready reference.

4.2.4 Preventive maintenance information shall be provided. Use of special tools, materials, and test equipment shall be specified, including model/type designation, as appropriate. The following procedures shall be stressed, if applicable:

4.2.4.1 Periodic cleaning and lubrication information, types of cleaning agents or lubricants required, recommended intervals, such as monthly, quarterly, semiannually, or hours of operation shall be provided.

Application points and capacity (required amounts) shall be identified. Pictorial format for lubrication is desirable. Cleaning and lubrication required during repair, replacement, and reassembly shall also be covered (See 4.2.6).

4.2.4.2 Instructions for inspection of equipment for damage and wear shall be included. Tabular or chart format is preferred and shall include, where applicable, allowable service limits, wear, backlash, end play, length and depth of scoring, and balance. These instructions shall be sufficiently complete to serve as standards by which experienced technicians may determine when parts may be continued in use and when they must be replaced.

4.2.4.3 Instructions shall be included for verification of system performance. The location of test connections and the values expected at these points shall be included, preferably in illustrated format. Data shall include a list of equipment required to accomplish the verification, such as temperature, vacuum, pressure, hydraulic, or pneumatic gages.

4.2.5 Failures that might occur during operation of equipment shall be listed. Troubleshooting data and fault isolation techniques shall state: (a) the indication or symptom of trouble, (b) the instructions necessary, including test hookups, to determine the cause, (c) special tools and equipment, and (d) methods for returning the equipment to operating conditions. Information may be in chart or tabular format with appropriate headings.

4.2.6 Instructions shall be provided for all removal, repair, adjustment, and replacement procedures. Exploded and sectional views giving details of assemblies shall be provided, as necessary, to clarify the text. For mechanical items, dimensional information with tolerances, clearances, wear limits, maximum bolt-down torques, and in-place balancing or other means of reducing noise level, if required, shall be supplied.

4.2.7 Notes, cautions, and warnings shall be used to emphasize important and critical instructions where necessary. Notes, cautions, and warnings shall immediately precede the applicable instructions, and shall be selected as follows:

NOTE: Concerns an operating procedure or condition which should be highlighted.

CAUTION: Concerns an operating procedure or practice which, if not strictly observed, could result in damage to, or destruction of equipment.

WARNING: Concerns an operating procedure or practice which, if not strictly observed, could result in injury to personnel or loss of life.

4.2.8 Manuals shall contain all illustrations necessary to locate and identify components of operational and maintenance significance. Where necessary for clarity, illustrations shall show configuration and the removal and disassembly of parts. The following types of diagrams shall be included: Schematic diagrams which show the arrangement of component devices

or parts; wiring diagrams which show the connections of the circuit arrangement; and schematic piping diagrams which show the interconnection of components, of piping, tubing, or hose, and the direction of air flow.

4.2.9 Circuit diagrams for electronic units shall be provided to support maintenance and troubleshooting. Circuit diagrams shall cross-reference repair parts shown in test tables and parts lists. The function name of each stage or circuit, primary signal flow, test points, wave forms with pertinent characteristics, electrical characteristics of parts, name of each variable control, input and output connectors/terminals voltages, and signals shall be specified. Voltage and resistance values measured with controls set for normal operation shall be shown for significant points, such as terminal boards and connectors. Interconnecting cable diagrams shall be furnished to show TO-FROM information, including any intermediate connections. Block diagrams shall be provided to support installation instructions, but shall not be substituted for necessary schematic diagrams.

4.2.10 Parts lists shall provide positive identification of parts necessary for support of the systems or equipment and shall include sufficient information to enable maintenance personnel to requisition replacement parts.

4.2.11 Clear and legible illustrations shall be provided to identify component parts and parts' relationships. Part numbers and part names may be shown on illustrations or separately listed. When the illustrations omit the part numbers and part names, both the illustrations and separate listings shall cross-reference illustrated part to listed part.

4.3 Format.

4.3.1 Wherever possible, commercial manuals will be incorporated without change in either content or format. The commercial manuals may be bound without disassembly in the facility manual, or may be disassembled and applicable portions incorporated into existing manuals.

4.3.2 The manual may be divided into volumes to prevent the manual from becoming too bulky.

4.3.3 The manual shall be oriented toward operation, maintenance, and repair of the equipment by the operators and maintenance personnel without the assistance of a manufacturer's representative.

4.3.4 The text shall be specific, concise, and clearly worded to be easily understood by personnel involved in the operation, maintenance, and repair of the equipment.

4.4 Manuscript Review. Draft manuscript copies, in the format and number as specified, shall be provided to the Government for review (See 4.). Operating and maintenance procedures, including checkout, calibration, alignment, scheduled removal and replacement instructions, and associated checklists shall be validated against the system (or equipment) in the presence of Government personnel.

4.5 Posted Instructions. Besides the operation and maintenance manuals, the following diagrams and instructions shall be furnished and installed, framed under glass or approved plastic laminate, and permanently posted within view of the installed system:

- Complete layout diagram to include all wiring, controls, system components, plumbing, valves, and regulators.
- Selective starting and stopping procedures.
- Checking procedure for normal operation.
- Abbreviated recommended preventive maintenance procedures.
- Emergency instructions.
- Warnings and precautions.

4.6 Field Instructions. After installation, startup, testing, and acceptance of the system, the contractor shall be required to supply the services of a competent representative for not less than 4 h to instruct local maintenance and operating personnel in the proper operation and maintenance of the complete system.

5. CONCLUSIONS.

This report includes the minimum requirements for central dental surgical handpiece drive air (SHDA) systems and associated centrally plumbed distribution networks for use in USAF dental health facilities. These specifications are interim until joint evaluations by the Dental Investigation Service and the Occupational and Environmental Health Laboratory establish standards for dental clinics. Any questions should be directed to USAFSAM/NGD, Brooks AFB, TX 78235-5301, AUTOVON 240-3502, commercial (512) 536-3502.

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